Remarks/Arguments

Objection to the Specification

The Specification has been currently amended to include appropriate section headings, as requested by the Examiner. Additionally, the location, page 1, after line 32, of the original Specification where the priority claim was inserted in the Preliminary Amendment was erroneous. This error was corrected in the currently amended Specification to appear immediately after the Title. No new matter has been added. The deletions made in pages 1-3 of the original Specification were made to eliminate unnecessary material.

Claim Objections

Claim 1 was objected to because of informalities. The Examiner objected to the phrase, "a transformer with a primary winding and an auxiliary winding for providing a supply voltage for the driver circuit". According to the Examiner, it is unclear if both the primary and auxiliary windings are used to power the driver circuit or if just the auxiliary winding powers the driver circuit.

Claim 1 has been currently amended to improve clarity by reciting the auxiliary winding that provides a supply voltage for the driver circuit. Thereby, the winding that provides the supply voltage for the driver circuit is clearly defined, in accordance with the Examiner's request.

In currently amended Claim 1, the last clause introduced by the word "or" has been deleted for avoiding any ambiguity. Instead, new Claim 9 includes the deleted clause. Additionally, in the new Claim 9, the element "a rectifier means for rectifying a mains voltage" of currently amended Claim 1 has been replaced by the element "bridge rectifier", as disclosed on page 4, 2nd paragraph of the original Specification.

Claim Rejections under 35 USC § 103

Claims 1-3 and 6-8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn (US 57422127) in view of Choo et al., (US 6674271) and

further in view of Zak (US 5619404) and Kang et al., (US 5170096). With regard to Claims 1 and 6, the Examiner explained that Ahn, in Figure 1, teaches a degaussing system with a demagnification coil (20), and contacts (S/W) arranged between the mains connection (PLG) and the coil, and that the switch is controlled by a pushbutton (BT). The Examiner explained that Ahn teaches mains line connected to a rectifier (30).

The Examiner admitted that Ahn does not teach that the degaussing circuit contains a switching power supply containing a transformer with primary and auxiliary windings, a switching transistor and a driving circuit to switch the transistor on and off.

The Examiner explained that the Choo et al., patent in Figure 2 teaches a switch mode power supply circuit wherein the circuit has a mains connection (AC) and a switch (SW2), and is comprised of a drive circuit (210), a transformer with a primary winding (Np) and an auxiliary winding (Na), wherein the auxiliary winding provides a supply voltage to the driver circuit. The power supply also includes a switching transistor (FET), driven by the driver circuit (210); the transistor is in series with the primary winding (Np). The circuit also contains a rectifier circuit (201) that rectifies the mains voltage. The circuit is turned on via a switching contact (SW2).The Examiner incorrectly stated that the circuit is turned off via switching contact (SW2).

The Examiner argued that it is obvious to combine the teachings of Ahn with Choo et al., by connecting a switching power supply to the degaussing circuit for the purpose of providing the CRT taught by Ahn with a power supply that consumes less power (referring to Choo et al., column 1, lines 15-20). The Examiner concluded that Ahn in view of Choo et al., teaches the circuit of Claim 1. The Examiner admitted that Ahn in view of Choo et al., does not teach that a main switch with first and second contacts is used to apply power to the demagnetizing coil and the driver circuit.

Claim 1 has been currently amended to recite more clearly patentably distinguishable features by including the limitations of the now cancelled Claim 3 and other limitations. Currently amended Claim 1 recites a circuit arrangement that includes a mains switch, a demagnetization coil and a switched mode power

supply for the operation with a mains voltage. A power factor coil is arranged between the mains connection and the bridge rectifier of the circuit arrangement.

The power factor coil recited in currently amended Claim 1 provides, advantageously, power factor correction. The power factor coil is arranged in front of the bridge rectifier, between the mains connection and the bridge rectifier. Because of its recited location, such coil can operate at the mains frequency (for example, 50 Hz or 60 Hz), advantageously, without conducting a direct current (DC) current component. Advantageously, such coil can be installed in an already available switched mode power supply that does not include power factor correction arrangement by simply adding the coil in front of the bridge rectifier. Such installation can be made with minimal modification and redesign changes. Similarly, removal of the power factor coil can be made with minimal modification and redesign changes by simply providing a current by-pass arrangement instead of the coil.

Because the power factor coil is arranged in front of the bridge rectifier, between the mains connection and the bridge rectifier, as recited in currently amended Claim 1, the same switch mode power supply can be easily adapted for use in countries not requiring power factor correction by avoiding the installation of the coil. Alternatively, in countries having respective power factor regulations or requirements the coil will be installed. Whether installed or not installed in a given power supply, the coil, advantageously, need not have any adverse effect on the operation of the power supply. This design adaptability provides a significant advantage relative to other known power factor correction solutions. Advantageously, only minor modifications to the switched mode power supply are needed for installing the power factor coil, thus avoiding additional expense.

If a switching contact of a power on/off switch were coupled in the current path of the current that flows in the power factor coil, arcs could adversely affect such switching contact, when the mains switch switches off the circuit arrangement. Because of the large inductivity of the power factor coil, high voltages could be produced at the switching contact.

Currently amended Claim 1 recites the second switching contact that is arranged between the auxiliary winding and the driver circuit for switching off the supply voltage. Such an arrangement, advantageously, can reduce arcs at the

switching contact. The circuit arrangement is switched off by switching off the driver stage of the switched mode power supply by means of a switching contact of the mains switch. Therefore, advantageously, arcing need not occur at the mains switch in the arrangement of currently amended Claim 1.

The cited reference Ahn, US 5,742,127, discloses a degaussing system for a cathode ray tube (CRT), which allows a user to provide degaussing while the CRT is on (see the Abstract). A degaussing is provided by means of a button and microcomputer control, when a user presses the button. In contrast to the recitations in currently amended Claim 1, nowhere does Ahn disclose a mains switch and a power factor coil for providing power factor correction.

The Choo et al., patent, US 6,674,271 B2, describes a switched mode power supply, which comprises a switch SW2. Switch SW2 is controlled by a user for providing a current via start up resistors R1 and R2 for switching on the power supply, as described in column 4, following line 64. The power supply is switched off by the system controller into a sleep mode after a predetermined time, as described in column 6, after line 38. Thus, in contrast to the recitation in currently amended Claim 1, switch SW2 of the Choo et al., patent is not capable of performing the dual function of switching on and switching off.

Moreover, in contrast to the recitations in currently amended Claim 1, nowhere do Choo et al., disclose a power factor coil for providing power factor correction. Because neither the Choo et al., patent nor the Ahn patent disclose a power factor coil for providing power factor correction, currently amended Claim 1 is patentably distinguishable and nonobvious over each and over a combination of the Choo et al., patent and the Ahn patent.

The Examiner stated that Kang et al, in Figure 1, teaches a degaussing circuit wherein the mains power is supplied to the switching power supply and to the degaussing coil when first and second contacts of the master switch (SW1) are closed. The Examiner argued that it would have been obvious to combine the teachings of Ahn in view of Choo et al., with Kang et al., for the purpose of saving production cost by replacing two separate buttons with one single button.

The Examiner admitted that Ahn in view of Choo et al., and further in view of Kang et al., does not teach that an energy storage capacitor is coupled between

the bridge rectifier and the primary winding, or that a power factor coil is arranged between the mains connection and the energy-storage capacitor.

The Kang et al., patent, US 5,170,096, discloses a circuit arrangement comprising a master switch SW1, a degaussing coil L2, a relay RS1 and a standby power supply for a microcontroller 2. The microcontroller switches off the degaussing operation of the degaussing coil.

In contrast to the recitations in currently amended Claim 1, nowhere do Kang et al., disclose a power factor coil for providing power factor correction. Because none of the Kang et al., patent, the Choo et al., patent and the Ahn patent disclose a power factor coil for providing power factor correction, currently amended Claim 1 is patentably distinguishable and nonobvious over each and over a combination of these three patents.

The Examiner stated that Zak, US 5,619,404, In Figure 2, teaches a switching power supply with a high power factor containing an energy storage capacitor (24) coupled between the rectifier means (20) and primary winding (23). The circuit also contains a coil (19) for providing power factor correction, which is arranged between the mains connection (13) and the energy storage capacitor. The Examiner argued that it would have been obvious to combine the teachings of Ahn in view of Choo et al., and further in view of Kang et al. with Zak, by placing the power factor corrector circuit in series between the mains connection and primary windings for the purpose of providing a near unity power factor to the power supply (column 1 lines 5 & 6).

Zak describes a switched mode power supply, which comprises an inductor 19 arranged between the bridge rectifier and the primary winding of a mains isolating transformer for a power factor correction. In contrast to the recitation in currently amended Claim 1, diode 20 is not "a bridge rectifier" and does not rectify "a mains voltage provided by said mains connection". This is so because the input voltage at the anode of diode 20 is already a direct current (DC) voltage. In Zak, it is bridge rectifier 16 that rectifies the voltage provided by source of AC power 13. However, in contrast to the recitation in currently amended Claim 1, power factor coil 13 of Zak is not arranged between AC power 13 and bridge rectifier 16. Therefore, coil 19 of Zak, unlike the coil of currently amended Claim 1, disadvantageously, must conduct a DC current.

Unlike the arrangement of currently amended Claim 1, the Zak arrangement has an additional disadvantage in that the power factor coil cannot be easily removed (for countries, in which no power factor correction regulation is required) without adversely affecting the operation of the power supply. This is so because coil 19 forms an integral part that is indispensable for the operation of the power supply; whereas, in the arrangement of currently amended Claim 1, whether the power factor coil is installed or is not installed in a given power supply, will have no adverse effect on the operation of the power supply.

None of the cited references relates to the problem of arcing between contacts of the main switch and to a respective aging, and how to solve such a problem in the manner recited in currently amended Claim 1. There is no motivation or suggestion in any of the cited references to combine it with any other of the cited references. It follows that recently amended Claim 1 is patentably distinguishable and non-obvious over each and over a combination of the cited references.

New Claims 9-14 are patentably distinguishable and non-obvious over each and over a combination of the cited references for reasons similar to those discussed with respect to recently amended Claim 1.

Allowance of Claims 1, 2, 4, 5 and 7-14 is respectfully requested.

Please charge the $1020 fee for filing the 3 month Request for Extension of Time, and any other fees that may be associated with the filing of this Amendment, to Deposit Account No. 07-0832.

Respectfully submitted,
WOLFGANG HERMANN ET AL.

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CUSTOMER NO.: 24498
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Response dated: May 18, 2006

Amendments to the Specification

Please substitute the Specification. A clear copy of the substitute Specification is provided in Attachment B and a marked-up version of the substitute Specification is provided in Attachment A.

ATTACHMENT A
Hannover, 18 Jan. 2006

PD020033*US

~~Circuit arrangement with power factor correction, as well as a corresponding appliance~~

CIRCUIT ARRANGEMENT WITH POWER FACTOR CORRECTION, AS WELL AS A CORRESPONDING APPLIANCE

This application claims the benefit, under 35 U.S.C. § 365 of International Application PCT/EP03/03826, filed April 12, 2003, which was published in accordance with PCT Article 21(2) on October 30, 2003 in English and which claims the benefit of German patent application No. 10217951.4, filed April 22, 2002.

BACKGROUND OF THE INVENTION

~~The present invention is based on a circuit arrangement having a switch-mode power supply as claimed in the precharacterizing clause of claim 1, and on an appliance having a corresponding circuit arrangement.~~

Switch-mode power supplies produce a heavily pulsed load on the electrical power supply system, which leads to harmonic currents in electrical power supply systems. This load occurs in the region of the voltage maxima of the sinusoidal mains voltage, at which voltage maxima an energy-storage capacitor for the switch-mode power supply is recharged. Appliances having a relatively high power consumption, such as televisions with relatively large picture tubes, now therefore have to comply with specific regulations relating to harmonic currents. The harmonic load on the electrical power supply system caused by an appliance can in this case be stated as a so-called power factor.

Widely differing circuit concepts are known for improving the power factor, for example from DE-A-196 10 762, EP-A-0 700 145 and US 5,986,898. These

contain a second current path with a coil between the mains rectifier and the primary winding of the transformer, with the inductance of this coil acting like a current pump, which is controlled by a switching transistor in the switch-mode power supply and in consequence broadens the pulsed current flow of the switch-mode power supply.

~~This application claims the benefit, under 35 U.S.C. § 365 of International Application PCT/EP03/03826, filed April 12, 2003, which was published in accordance with PCT Article 21(2) on October 30, 2003 in English and which claims the benefit of German patent application No. 10217951.4, filed April 22, 2002.~~

A further possible way to improve the power factor of a switch-mode power supply is to use a coil in the input area of the switch-mode power supply. This coil is also referred to as a 50 Hz coil, a mains frequency coil or a power factor coil. In order to avoid confusion with other coils, the description therefore always uses the expression power factor coil for this coil.

However, this power factor coil has the disadvantage that the current flow in the power factor coil is interrupted suddenly when the mains switch is operated in order to switch off the appliance. The energy which is stored in the coil must be dissipated, however. Since the open mains switch represents the highest impedance in the circuit, a very high voltage is therefore developed across the switching contacts of the mains switch, and causes an arc. This causes the mains switch to age more quickly, and the switch represents a safety risk since, in the worst case, it becomes a potential fire source.

ATTACHMENT A

Other mains switches, in which the switching contacts open at a slow rate, are likewise at risk. In this case, although the voltage across the contacts is not very high, an arc is nevertheless produced, however, and burns until the end of the corresponding power supply system half-cycle. In this case as well, a large amount of energy is lost in the switch, which leads to rapid aging.

~~The object of the present invention is to specify a circuit arrangement and a corresponding appliance of the type mentioned initially, which have high reliability with a circuit complexity that is as economic as possible.~~

~~For a circuit arrangement, this object is achieved by the features of claims 1, 7 and 8, and for an appliance it is achieved by the features of claim 9. Advantageous developments of the invention are specified in the dependent claims.~~

BRIEF SUMMARY OF THE INVENTION

The circuit arrangement ~~according to the invention~~ has a mains connection, a mains switch with two switching contacts, a demagnetization coil and a switch-mode power supply, which contains a driver circuit for producing a control voltage for the switching transistor of the switch-mode power supply. A first switching contact of the mains switch is arranged here between the mains connection and the demagnetization coil in order to switch the demagnetization coil on and off, and the second switching contact is connected to a supply or control voltage for the driver circuit, in order to switch off the control voltage for the switching transistor or in order to switch off the switch-mode power supply.

This has the advantage that a power factor coil between the mains connection and the switch-mode power supply can be used for power factor correction, and that the mains switch is not loaded by the inductance of the power factor coil. Admittedly, this results in the switch-mode power supply being connected to the mains even when it is switched off. However, this is not disadvantageous for the user and leads only to a slight power loss resulting from the starting circuit, when the switch-mode power supply is switched off.

The circuit arrangement can be used in particular in appliances having a picture tube, for example televisions and computer monitors. This mains switch circuitry in this case ensures that the picture tube is demagnetized whenever the appliance is switched on.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be explained in more detail in the following text using, by way of example, an exemplary embodiment which is illustrated schematically in the figures, in which:

Figure 1 shows a circuit arrangement having a mains connection, a power factor coil and a switch-mode power supply, as well as a mains switch, and

Figure 2 shows the use of the arrangement in a chassis of a television.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows a switch-mode power supply I schematically, which has a rectifier means, in this exemplary embodiment a bridge rectifier BR with four

diodes, an energy-storage capacitor C1 and transformer TR with a primary winding W1, an auxiliary winding W2 arranged on the primary side and secondary windings W3, W4 and W5 arranged on the secondary side. The energy-storage capacitor C1 is in this case arranged between the bridge rectifier BR and the primary winding W1. A switching transistor T1 is connected in series with the primary winding W1 and is controlled by a control voltage DS for a driver circuit DC. A supply voltage VCC is provided for operation of the switch-mode power supply via the auxiliary winding W2, a diode D1 and capacitor C2, and is supplied to the driver circuit DC.

The switch-mode power supply I in Figure 1 is a part of a circuit arrangement which also has a mains connection NA, a demagnetization coil (which is not illustrated) and a mains switch S1 with two switching contacts 1, 2. The circuit arrangement is preferably integrated in an appliance, for example a television, which has a picture tube.

Picture tubes, which are used in televisions or computer monitors, need to be demagnetized from time to time in order to preserve the color purity of the picture tube. This is accomplished by means of a demagnetization coil, through which an AC voltage normally flows during the process of switching on the appliance. The 220 volt mains voltage is used as the AC voltage in this case and produces a high current surge at the time when the appliance is switched on, and which then subsequently decays gradually. The decay is accomplished by means of a posistor, which is heated by the high current with its impedance in consequence becoming high.

In order to regulate the switch-mode power supply, the driver circuit DC is supplied with a regulating signal

RS which is derived from a supply voltage U4 on the secondary side, for example from the system voltage in a television, and is transmitted via an opto coupler or an isolating transformer (which is not illustrated) to the primary side of the switch-mode power supply.

A so-called snubber network SN is arranged in parallel with the primary winding W1 and is used to damp voltage spikes which occur during the process of switching off the switching transistor T1. The switch-mode power supply also contains a starting circuit AS, which supplies the driver stage DC with a current for the starting phase of the switch-mode power supply after the appliance in which the circuit arrangement is integrated has been switched on. The starting circuit AS is normally a high-value resistor chain, which produces a connection between the bridge rectifier BR and the capacitor C2. During operation, the supply voltage VCC is produced by the auxiliary winding W2, as well as by the diode D1 and the filter capacitor C2.

The switch-mode power supply illustrated in the figure preferably operates on the basis of the fly back converter principle, although other circuit principles are likewise possible. Fly back converters are preferably used in entertainment electronics appliances, for example in televisions and video recorders. In a fly back converter, energy is in this case stored in the transformer TR during the phase in which the switching transistor T1 is switched on, and is then subsequently transmitted to the windings W3-W5 on the secondary side, and to the auxiliary winding W2 on the primary side, in the phase during which the switching transistor is switched off. Fly back converters are used both as AC/DC converters and as DC/DC converters.

Switch-mode power supplies of this type have a low power factor, since the energy-storage capacitor C1 is recharged only in the region of the voltage maxima and minima of the 50 Hz mains voltage, when the output voltage U2 of the bridge rectifier BR exceeds the voltage value across the energy-storage capacitor C1. One simple possible way to improve the power factor of a switch-mode power supply is to use a mains frequency coil or power factor coil NS, which is arranged between the mains connection NA and the energy-storage capacitor C1. In this exemplary embodiment, it is connected between the mains connection NA and the mains rectifier BR.

The power factor coil NS results in the pulsed current flow which is used to recharge the energy-storage capacitor C1 being broadened and shifted in phase, since the inductance of this coil, for example 50 mH, means that the current flow through the coil rises only gradually, and decays again in a damped manner. A power factor which complies with the requirements is achieved in this case by appropriate choice of the inductance value.

Figure 1 likewise shows a mains switch S1, which has two switching contacts 1 and 2, as well as corresponding connections a and b for the switching contact 1, and c and d for the switching contact 2. The mains switch S1 is in this case normally arranged on the front face of the appliance, such that it is easily accessible for a user. The connections c and d are in this case according to the invention connected to the connections c' and d' for switching the driver circuit DC of the switch-mode power supply on and off, and the connections a and b are connected to the magnetization coil for switching the demagnetization coil on and off.

In consequence, the power factor coil NS is not arranged in the current path of the mains switch S1. The mains switch is therefore not loaded by the power factor coil NS when the appliance is switched on and off. At the same time, this arrangement ensures that the demagnetization coil is switched on, in order to demagnetize the picture tube, on each occasion when the appliance is switched on.

Figure 2 shows the major components of the circuit arrangement, to the extent that they are integrated on a chassis of a television in an advantageous refinement. On the input side, the arrangement has a filter section with a mains filter NF, capacitors C3 and C4 and a resistor R1, which filter section is connected to the mains connection NA of the arrangement. This filter section prevents radiated interference from the appliance entering the mains system and suppresses any interference which is already present on the mains system. On the output side, the filter section is connected to the bridge rectifier BR, which provides the rectified voltage U2 for operation of the switch-mode power supply.

Connections e and f are arranged in the connection between the bridge rectifier and the filter section, to which the power factor coil NS, which is not illustrated in Figure 2, is connected. The power factor coil is arranged separately, so that the switch-mode power supply can be kept compact and, in particular, such that an already existing switch-mode power supply which does not have power factor correction can be used without any major design change. The arrangement of the power factor coil NS upstream of the bridge rectifier BR means that it is located in the current path of the sinusoidal AC voltage of the mains system.

The driver circuit DC and the transformer TR for the switch-mode power supply are indicated only schematically in Figure 2, to the extent that it is necessary for understanding of the invention. As already explained with reference to Figure 1, a diode D1 and a capacitor C2 are arranged on the auxiliary winding W2, which is arranged on the primary side, in order to produce the operating voltage VCC for the driver circuit. Two connection points c' and d' are arranged on the chassis in the connection between the capacitor C2 and the driver circuit DC, and are connected to the connection points c and d of the mains switch S1.

A capacitor C6 with a capacitance of 1 µF is also advantageously connected to ground between the connection c' and the driver circuit DS, and is used to avoid switch bouncing of the switching contact 2 and to provide filtering for the long supply line to the mains switch S1. The capacitance of this capacitor in this case also influences the number of switching cycles after which the switching transistor T1 is completely switched off.

A posistor PS and a capacitor C5 to which the demagnetization coil ES (which is not illustrated) is connected via connection points g and h are also arranged on the chassis. On the input side, the posistor PS is arranged in parallel with the capacitor C3. Connection points a' and b', which are connected to the connection points a and b of the mains switch S1, are in this case located in a supply. In consequence, the demagnetization coil ES is switched on whenever the mains switch S1 is operated in order to switch on the appliance. The posistor PS in this case ensures a large current surge at the moment of switching on, which is

reduced continuously to a low loss level by the heating of the posistor.

Whenever the appliance is switched, when the mains switch S1 is pressed, the switching contacts 1 and 2 are closed, so that the switch-mode power supply can be started via the switching contact 2, since the driver circuit DC is in this case supplied with the operating voltage VCC. On being switched on, the switch-mode power supply thus behaves in precisely the same way as when using the mains switch S1 in appliances of a conventional type.

Whenever the appliance is switched off, when the mains switch S1 is opened, the switching contact 2 switches off the switching transistor T1 in a short time, so that no more energy is transmitted in the transformer TR to the second windings W2 - W5. The switching voltage DS for the switching transistor T1 is switched off directly or indirectly by the driver circuit. The switching contact 2 is advantageously connected to the connection points c' and d', as described with reference to Figure 2, so that the driver circuit DC is disconnected from the supply voltage VCC during the switching-off process. However, another voltage of the driver circuit DC, for example a control voltage for the driver circuit DC, can also be switched off in a corresponding manner by the switching contact 2, or the switching contact 2 can be used to regulate the regulating signal RS at a predetermined voltage level, so that the switching transistor T1 is likewise switched off permanently.

According to the invention, the mains connection NA is thus connected to the bridge rectifier BR without being switched, without a mains switch. The switch-mode power supply I is thus always connected to the electrical

power supply system whenever the mains plug of the appliance is connected to the electrical power supply system. In consequence, the power factor coil NS is not arranged in the current path of the mains switch S1, so that the life of the mains switch S1 is considerably improved.

Further refinements of the invention are within the scope of a person skilled in the art. The invention is not restricted to switch-mode power supplies based on the flyback converter principle, as already explained above, and can also be used for other switch-mode power supply concepts when power factor correction is required. The invention can also be used in appliances which do not have power factor correction. Thus, for example, the connection points e and f can be short-circuited in appliances for countries which do not require power factor correction. In consequence, there is no need to modify the chassis in these appliances for these countries.